Dust Emission from High Latitude Cirrus Clouds

N91-14930

Rene J. Laureijs, G. Chlewicki, F.O. Clark, P.R. Wesselius

Laboratory for Space Research and Kapteyn Astronomical Institute
P.O. Box 800, 9700 AV Groningen
The Netherlands

Abstract

In order to study dust emission from grains in the interstellar medium, we analyzed the infrared properties in a number of isolated high latitude dust clouds ($b \geq 10^o$) which contain no dominant internal heating sources. The clouds are spatially resolved, have a simple geometry and are mapped in the IRAS bands at 12, 25, 60 and 100 μm. For a number of these clouds we obtained extinction data (A_B) from starcounts.

A significant part (30 to 50 %) of the infrared radiation of the clouds in the IRAS wavelength range of 8-130 μm is emitted in the short wavelength bands at 12 and 25 μm. The 60/100 μm ratios for the integrated fluxes of the clouds have a typical value of 0.19±0.05. The 12/100 μm ratios in the sample show a considerable variation and range from 0.03 to 0.14 with an average value of 0.07. We find a ratio $I_\nu(100\ \mu m)/A_B$ between 5 and 8 MJy/mag, which is significantly lower than the ratio found in other studies. From the 12 and 25 μm morphology, which is dramatically different from the morphology at 60 and 100 μm, we infer that the short wavelength emission emerges from the outer parts of the clouds.

Examination of the individual brightness profiles of the clouds shows a nearly constant 60/100 μm brightness ratio as a function of opacity in the cloud. The brightness distribution in several of the most regular clouds shows an initial rise in the ratio towards higher opacities. This observation directly proves that the emission in the two bands cannot be due to a single population of equilibrium grains. The 12/100 μm ratio drops steadily as a function of opacity. Such a relationship must be caused by particles which absorb strongly in the UV. The 100 μm surface brightness remains proportional to blue extinction up to almost 2 magnitudes. The very slow decline of the grain temperature that the relation implies can only be reproduced in models if the particles are allowed to absorb at wavelengths as long as 1 μm.

To model the observations we require particles absorbing mainly at UV wavelengths and emitting at 12 and 25 μm, an emission component around 60 μm due to particles at a high (50 K) temperature, and strongly absorbing grains in the visual and near infrared to account for the linear relationship between $I_\nu(100\ \mu m)$ and A_B.

PAGE 132 INTENTIONALLY BLANK   PRECEDING PAGE BLANK NOT FILMED